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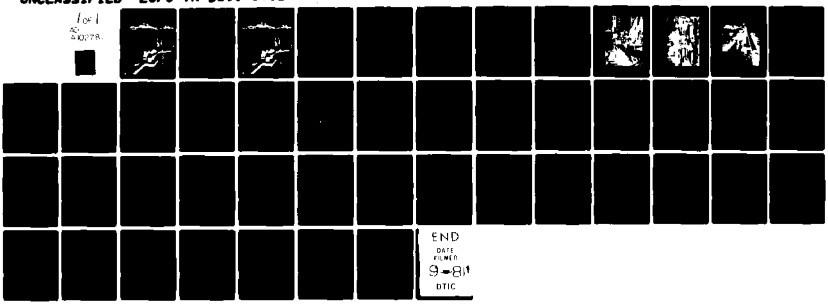

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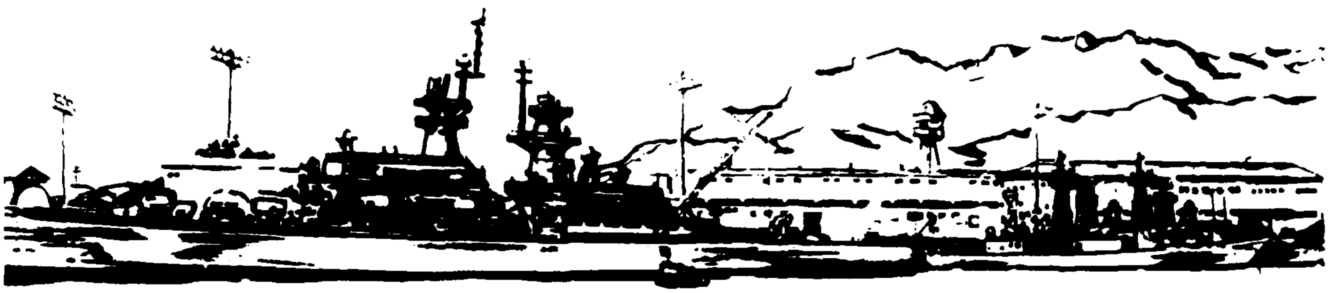

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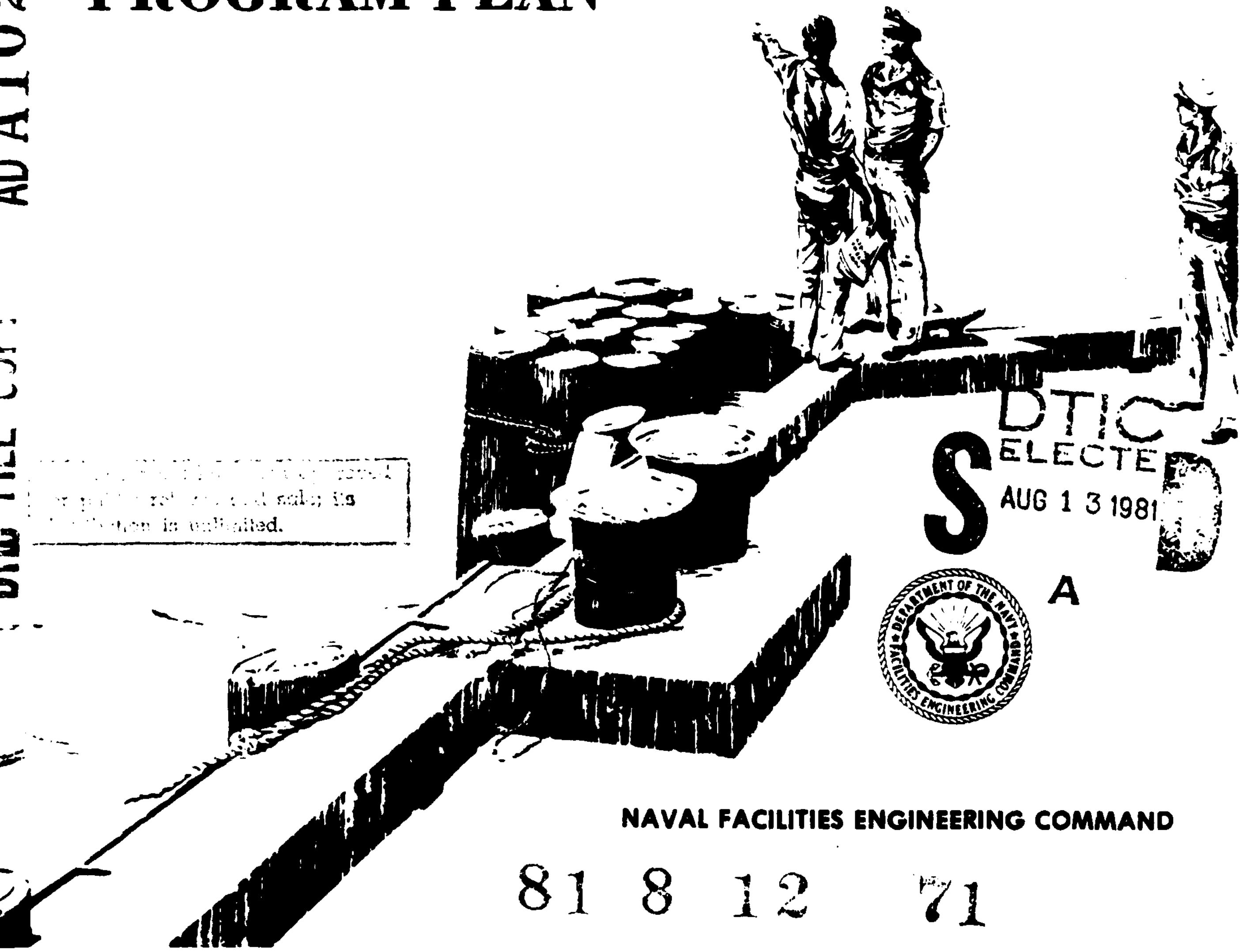

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This document describes the development activities planned by the Naval Facilities Engineering Command to enhance the operational efficiency of U.S. Navy Ports. Three areas of effort are described. These are the determination of waterfront facility requirements, development of advanced engineering concepts and development of acquisition strategy concepts.

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PORT SYSTEMS PROJECT (PSP)
PROGRAM PLAN

NAVAL FACILITIES ENGINEERING COMMAND

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SECTION I
INTRODUCTION

1.1 BACKGROUND.

The purpose of Naval Ports is to provide onshore logistic services to the fleet while ships are in port. Effective port services and port facilities impact directly on the efficiency of the material condition of the ships in the fleet and on the effectiveness of the Navy Personnel afloat and ashore. Effective port facilities and services alleviate the need for use of shipboard equipment while pierside, and improve personnel morale and welfare by increasing functional effectiveness and providing increased off duty hours for sailors. The Chief of Naval Operations (CNO) has called command attention to application of resources to the "Improvement of Material Condition of Ships in the Fleet", "Appearance/Smartness of the Shore Activities", and "Improving the Quality of Morale and Welfare of Navy Personnel Afloat and Ashore".

During the past several years, there has been increased emphasis on the construction of new waterfront facilities through the military construction program and on the repair of existing waterfront facilities. This increased emphasis has resulted from a recognition that the Navy now has a shortage of modern waterfront facilities with sufficient depth of water and utilities support and that many of the facilities are in poor condition.

In late 1976, an analysis was made of the capabilities of our major homeports to berth (with utilities support) the ships contemplated in the planned ship building program through 1985. This study identified a major requirement for new construction, and, in POM 79 development, the CNO directed a multi-year program totalling $380 million. As a first increment, the FY79 MILCON budget included approximately $80 million in new waterfront facilities.

During these studies of the requirements, it was clear that the Navy should reexamine the past and current concepts for providing waterfront support to insure that the new facilities that are built meet the needs of future ships in the best possible way, at lowest cost and with due consideration of the many constraints that will exist, i.e., land shortage, environmental pressures. In recognition of this need for a reexamination, OP-44 initiated an advanced development project in FY79 to develop new facilities acquisition, maintenance, and disposal strategies which will readily accommodate the overall logistics support envisioned for the future Navy.

1.1.1 Problem.

Most waterfront facilities in Naval ports were installed some 30 to 40 years ago. The age of most ships range from 5 to 20 years, with the majority of these being 15 years old (approximately 35 percent). Due to this age difference, the port services provided by these facilities have been outmoded and cannot meet the cold iron requirements of today's ships. These inadequacies necessitate jury rigging to satisfy the demands, and cause pier congestion, misuse of facilities, inefficient services and a potential reduction in fleet readiness (see Figures 1-1, 1-2, and 1-3). With age, some piers have deteriorated to the extent that structural integrity is no longer assured.

In recent years, the increased complexity of ships systems and the imposed environmental and energy constraints on fleet operations have generated major changes in port service requirements. Due to the rapid technological developments in combat weapon and onboard auxiliary systems, port facilities demands are changing faster than the acquisition cycle to construct waterfront facilities. These significant changes in fleet requirements have surfaced a need for more dynamic techniques for forecasting the logistic support for port facilities.

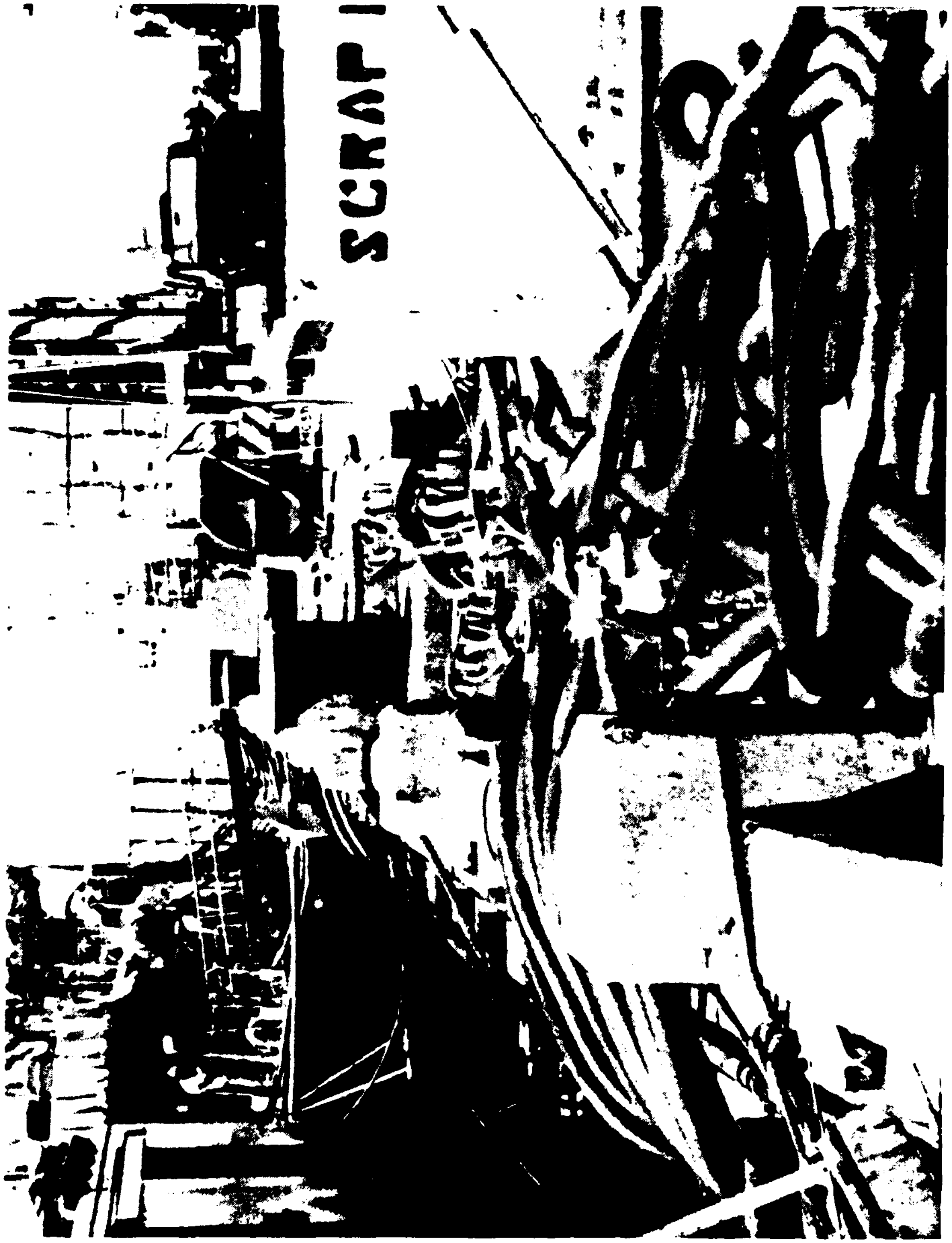

Figure 1-1. Electrical Lines on Pier

Figure 1-2. Heavy Traffic Congestion

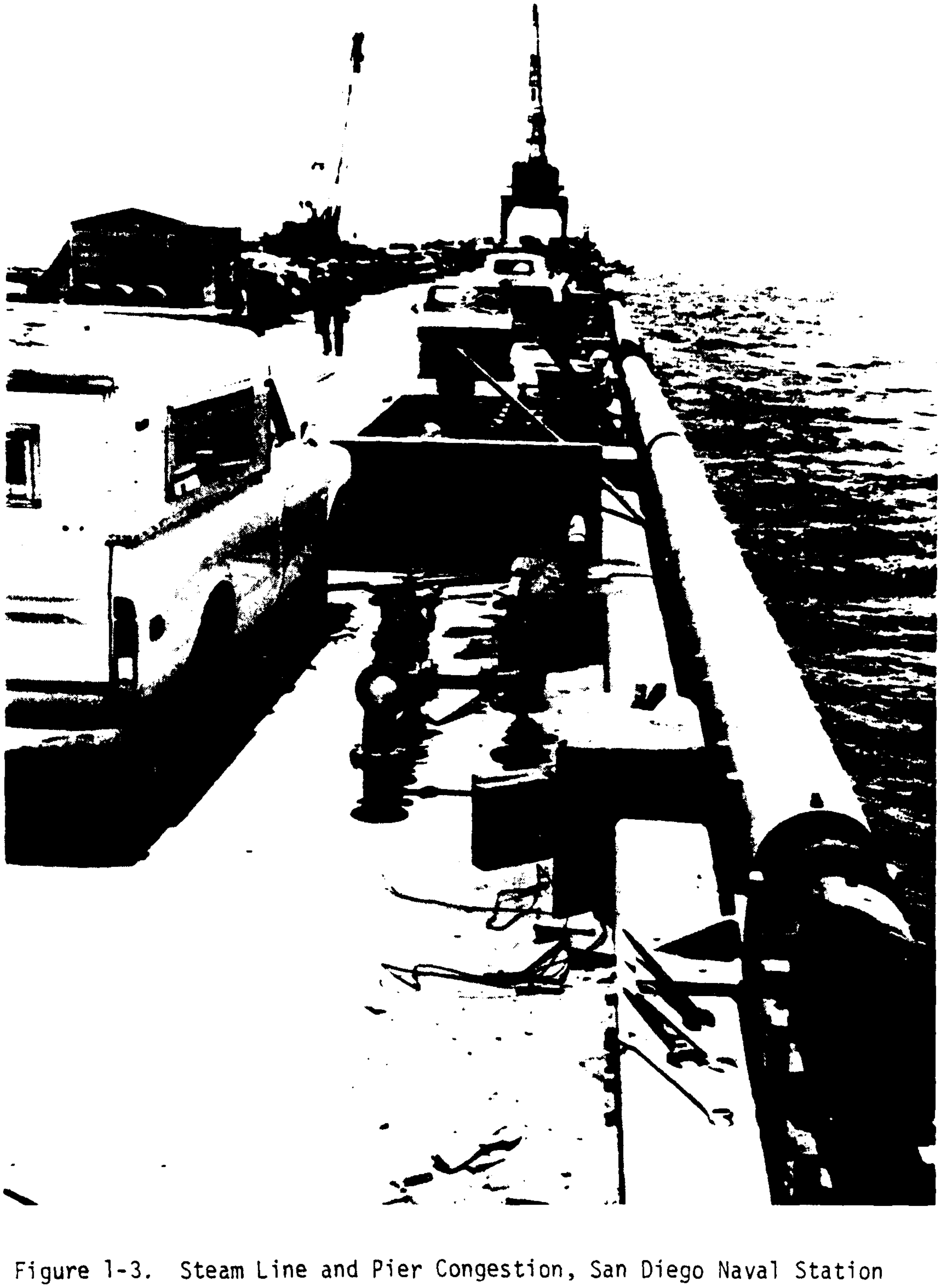

Figure 1-3. Steam Line and Pier Congestion, San Diego Naval Station

1.1.2 Solution Approach.

It is not economically feasible to upgrade all waterfront support facilities to provide 100 percent support 100 percent of the time to the most demanding mix of ships at the present and in the future (2010). Material concepts, ship demand functions, and investment/maintenance strategy models may provide requisite support without acquisitions predicated on worst case combination of factors. In recognition of the waterfront facilities deficiencies the Navy Decision Coordinating Paper for Naval Facilities Systems (NDCP Y-0995-SL) has included an R&D project for Port Systems for the Fleet of the 1990s.

1.2 PURPOSE AND SCOPE.

This Program Plan provides guidance by which the Principal Development Activity (PDA) directs and controls program activities. The basic tasks, schedules and developmental sequences delineated herein provide the parameters to which the activities participating in the program will adhere. Basic documentation, definition and direction will be provided. Detailed technical development plans for the various major R&D efforts will be developed, as required. They will reflect the level of detail deemed essential to the PDA. These detailed plans will conform to the overall guidance of the Program Plan. Additionally, this plan is intended to be a "working" document with changes and corrections promulgated periodically to reflect the dynamic nature of the R&D effort.

1.3 PROGRAM OBJECTIVES.

1.3.1 General.

This project will develop material concepts and techniques for planning and designing port facilities that can be implemented at acceptable levels of risk and affordable cost to meet the projected fleet

requirements of the 1990s and beyond. The project will provide both short-term and long-term products. The short-term program will address methods to upgrade existing facilities; the long-term, program, new concepts for piers and port operations.

1.3.2 Specific Performance Objectives.

The Port Systems Project will provide the following capabilities:

- predict the port services demands as the fleet changes in composition, size and homeporting plans;
- provide alternate design options for upgrading existing facilities;
- provide alternate design options for the construction of new waterfront facilities; and
- provide analytical tools for determining optimum port services.

1.4 DEVELOPMENT EFFORTS.

The Port Systems Project will develop the following:

a. data bases and methods to forecast needs,
b. advanced waterfront facilities concepts, subsystems and components, and
c. methods to facilitiate optimum decisions in facilities investments, ship design/SHIPALTS, and waterfront operating practices.

This project includes development efforts in three broad areas including waterfront facility requirements, advanced engineering concepts, and acquisition strategy criteria. The results of these efforts will be demonstrated through the development of notional port facilities at San Diego, California and Norfolk, Virginia. The approach for this project is shown in Figure 1-4.

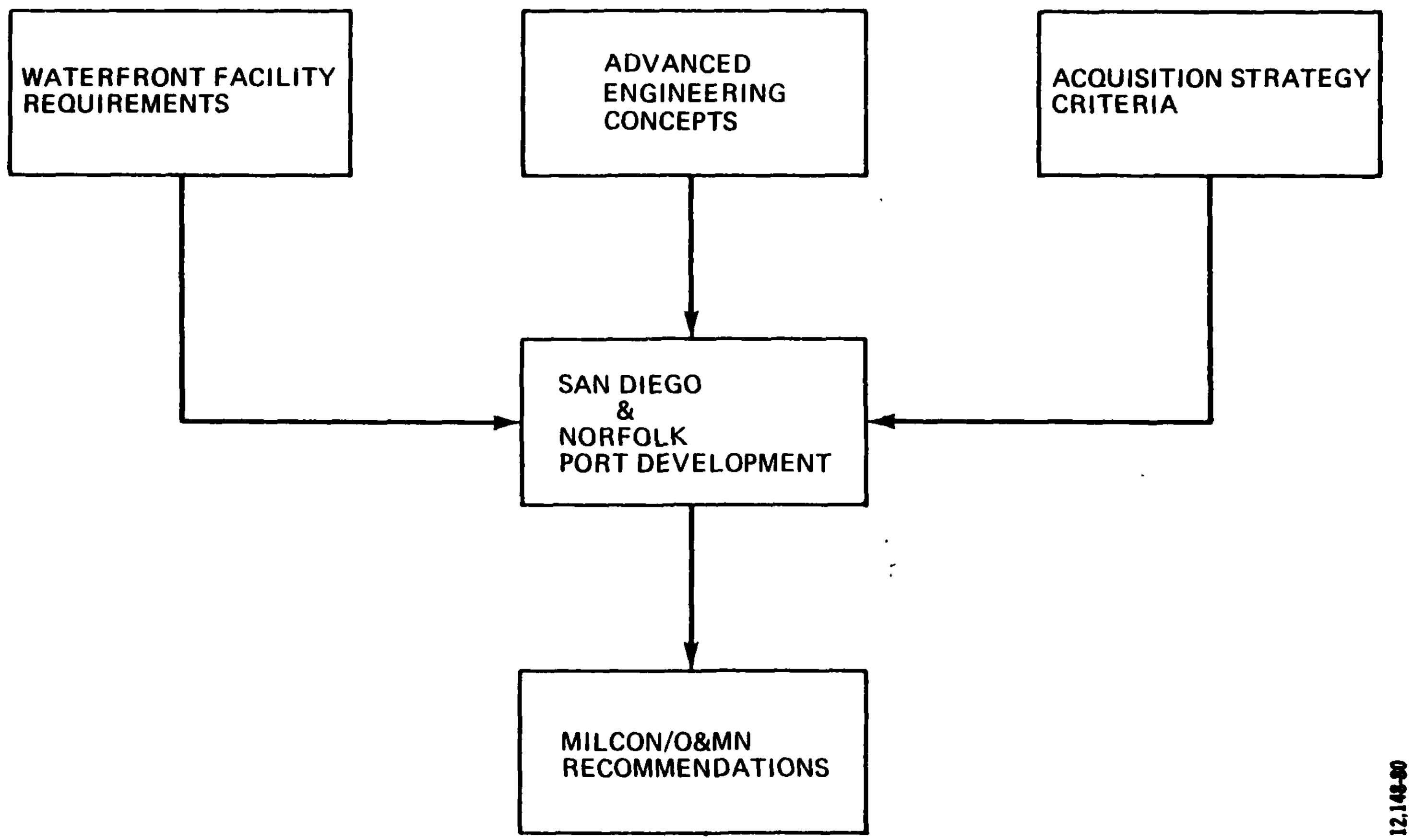

Figure 1-4. PSP Approach

1.4.1 Waterfront Facility Requirements.

The effort will generate data bases and develop a dynamic model for forecasting diversified port demands. The methodology to keep this data updated will be developed. Data bases will be generated on individual ship demands, aggregate ship demands, port loading factors, and future trends in ship platforms and fleet operational procedures.

1.4.2 Advanced Engineering Concepts.

The development of new concepts will be directed toward developing designs that will specifically reduce: (a) over taxing of sailors while in port, (b) shipboard wear/tear, (c) ships readiness downtime, and (d) continuous patching of waterfront fleet support systems. The development of engineering concepts will be focused in the following areas:

a. Pier configuration
   (1) Shape (i.e., Delta)
   (2) Multi-level
   (3) Floating/relocatable
   (4) Design for expansion
b. Mechanization, mobility, and modularity of utilities
c. Weight and materials handling
d. Components and materials
e. Peripheral items

Engineering and cost-effectiveness data on alternative facilities, equipment, and services concepts which will best meet the anticipated operational needs of the fleet of the 1990s will be produced. This data will include performance, reliability, maintainability, and cost data on each alternative concept, which will be documented and used to update NAVFAC design and planning criteria. Concepts for modifying/upgrading existing facilities and for constructing new piers and other waterfront structures will be investigated.

1.4.3 Acquisition Strategy Criteria.

This effort will generate economic data bases and develop the methodology to facilitate decisions in facilities investments, waterfront operating procedures, and changes in ship designs. Basically, these models will be developed for the purpose of evaluating various facilities and fleet options, such as:

a. Should facilities be repaired? replaced? expanded? modified?
b. Do we change waterfront operating procedures?
c. Do we change ship designs?
d. Do we design to today's or tomorrow's requirements?
e. Do we design to now, +5, +10, +20 years?
At what cost premium?
At what level of uncertainty?

1.4.4 Test and Evaluation.

The results of the above effort will be demonstrated through the development of notional port facilities at San Diego, California and Norfolk, Virginia. This will provide a valid exercise of the models.

SECTION II
PROGRAM MANAGEMENT

2.1 ORGANIZATIONAL STRUCTURE.

The Naval Facilities Engineering Command (NAVFAC) is the Port Systems Project (PSP) Principal Development Activity (PDA). The PDA is responsible for overall program management and technical development. A CNO Steering Group chaired by OP-04 with membership including OP-02, OP-03, OP-05, and OP-96 has been established to periodically evaluate the direction of the project to be certain it is meeting the real needs of the fleet of the future. The group will provide guidance concerning future fleet operations and composition. This group will also advise on proposed changes in waterfront operations and homeporting policies.

The organizational structure for the implementation of this project is depicted in Figure 2-1. NAVFAC Code-03 will be responsible for the management of the project. Technical Advisory Groups (TAGs) will be established to provide technical guidance in the major service areas of the PSP. These TAGs will consist of representatives from the appropriate NAVFAC Codes, EFDs and PWCs. They will be responsible for providing technical guidance to the project. NAVSEA will provide technical inputs on current and future ship requirements for import services. Major Fleet and Type Commanders will be consulted and briefed periodically during the progress of the project as to obtaining appropriate inputs and feedback.

The primary performing activity for the PSP is the Civil Engineering Laboratory (CEL). CEL will employ other Navy Activities and contractors, as required to accomplish the development effort. CEL will be responsible for developing the detailed plans for execution of the project in each of the areas of waterfront facility requirements, advanced engineering concepts, and waterfront operating strategy options. The elements of each of the major areas are shown in Figure 2-2.

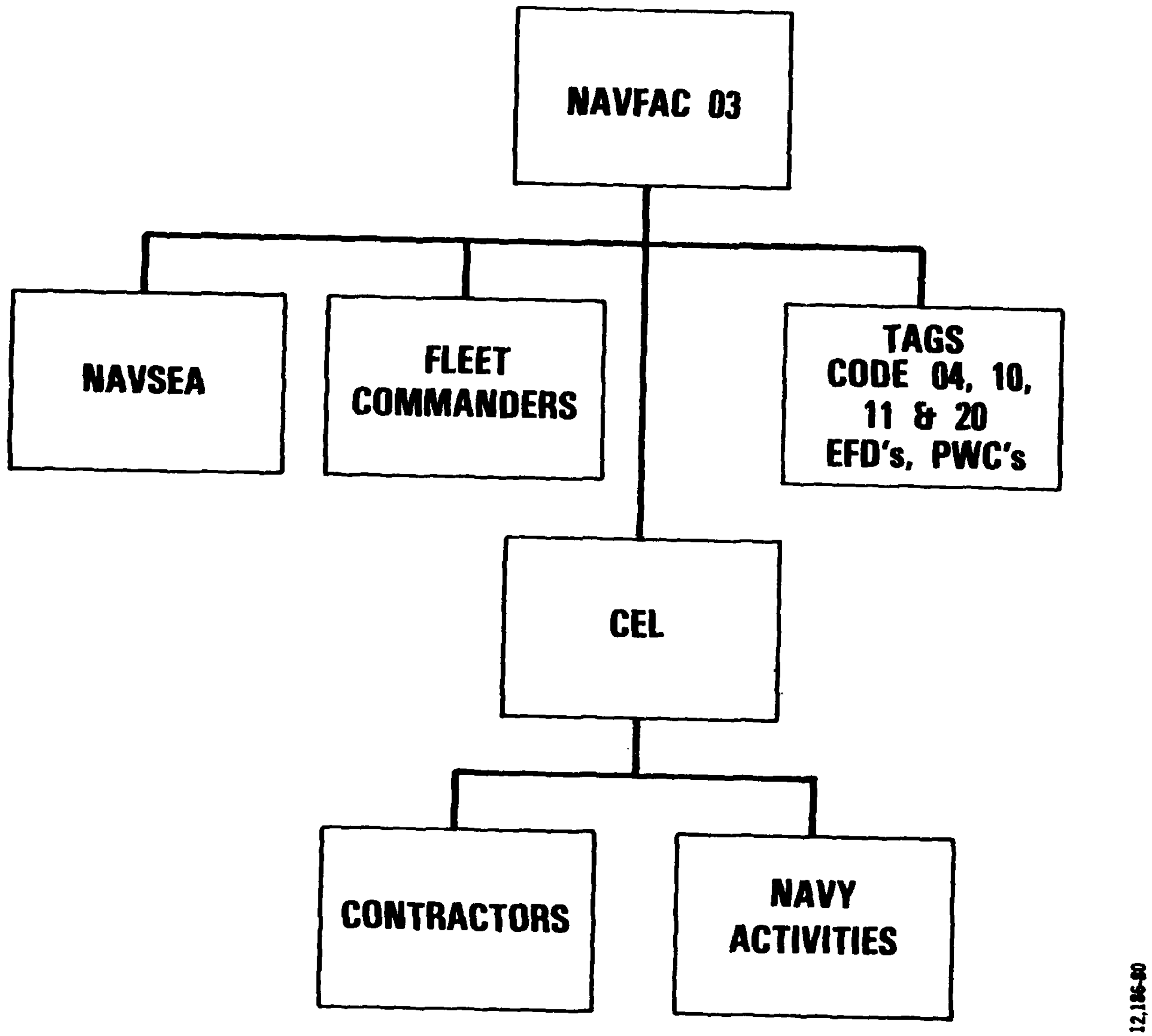

Figure 2-1. PSP Organization

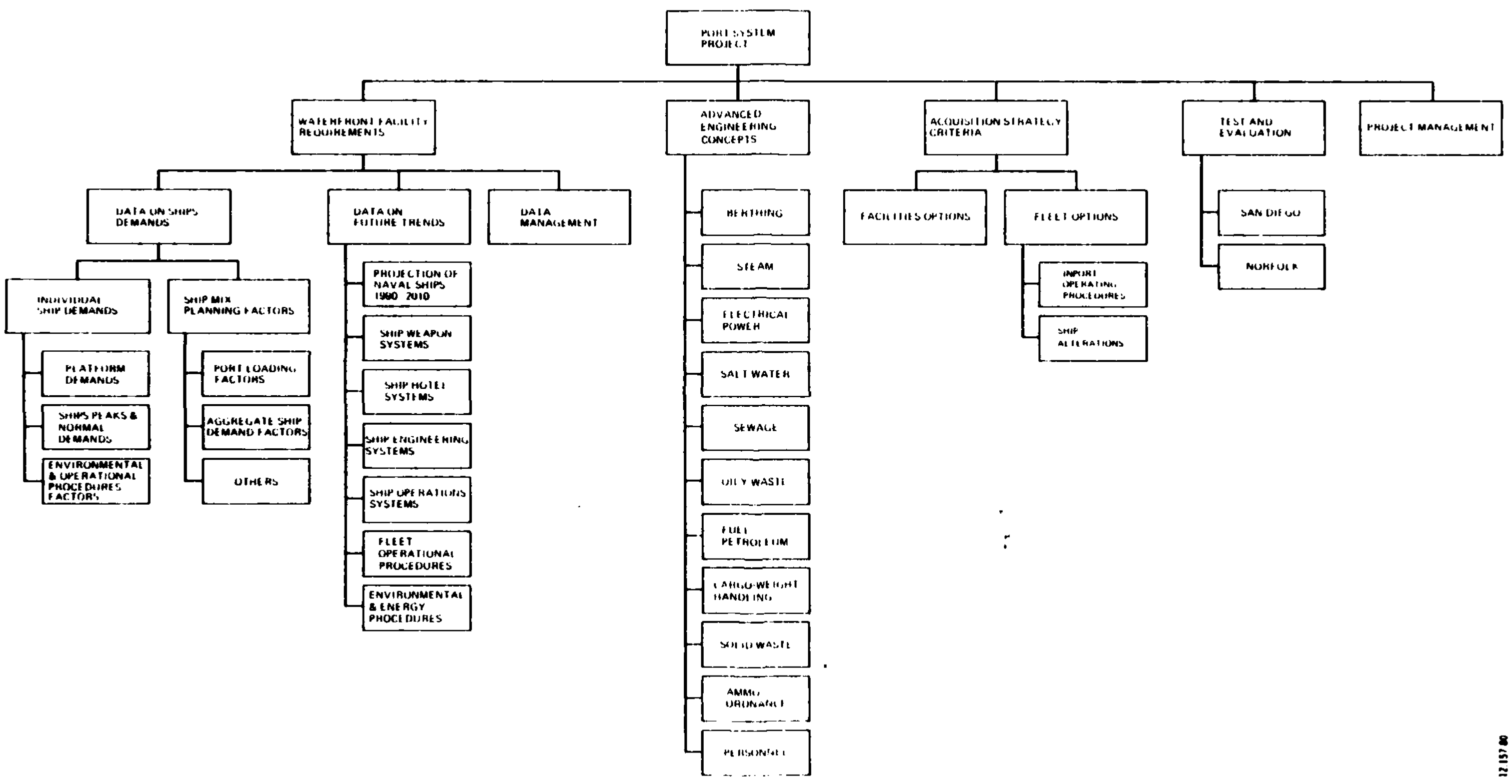

Figure 2-2. Port System Project Elements

2.2 PROGRAM CONTROL.

This Program Plan is the overall control document for the PSP development effort. Detailed technical development plans for the various project activities shall comply with the guidance provided herein including program scheduling sequences. The program milestones are shown in Figure 2-3.

2.2.1 Project Review Requirements.

The primary performing activity (CEL) shall conduct project review meetings with the PDA on a quarterly basis. The particular time, scope, and details of the meeting will be coordinated between the PDA and project manager involved. Although such reviews are intended to be informal in nature, it is expected that, as a minimum, the following items will be covered: (1) major milestones achieved; (2) funds expended per task; (3) contracts initiated; (4) major technical findings; and (5) potential problems impacting cost, schedule or technical risk. Other items will be included as necessary.

2.2.2 Data Requirements.

Project data, reports and technical documentation are expected to be in good engineering format. Project documentation that relates to overall PSP development should reference the guidance and program relationships delineated in this Program Plan. Advance copies of all project reports should be forwarded to the PDA for comment prior to publishing.

Because of the nature of the products in this project, a Test and Evaluation Master Plan (TEMP) will be prepared for each of the components as appropriate. The intent of OPNAVINST 3960.10 will be followed and any field test results will be documented for appropriate decision making.

The products developed in this project will be examined for requirements of a Reliability, Availability, and Maintainability (RAM) analysis. RAM considerations will be incorporated into the design of any products. As appropriate, a RAM analysis will be generated and documented.

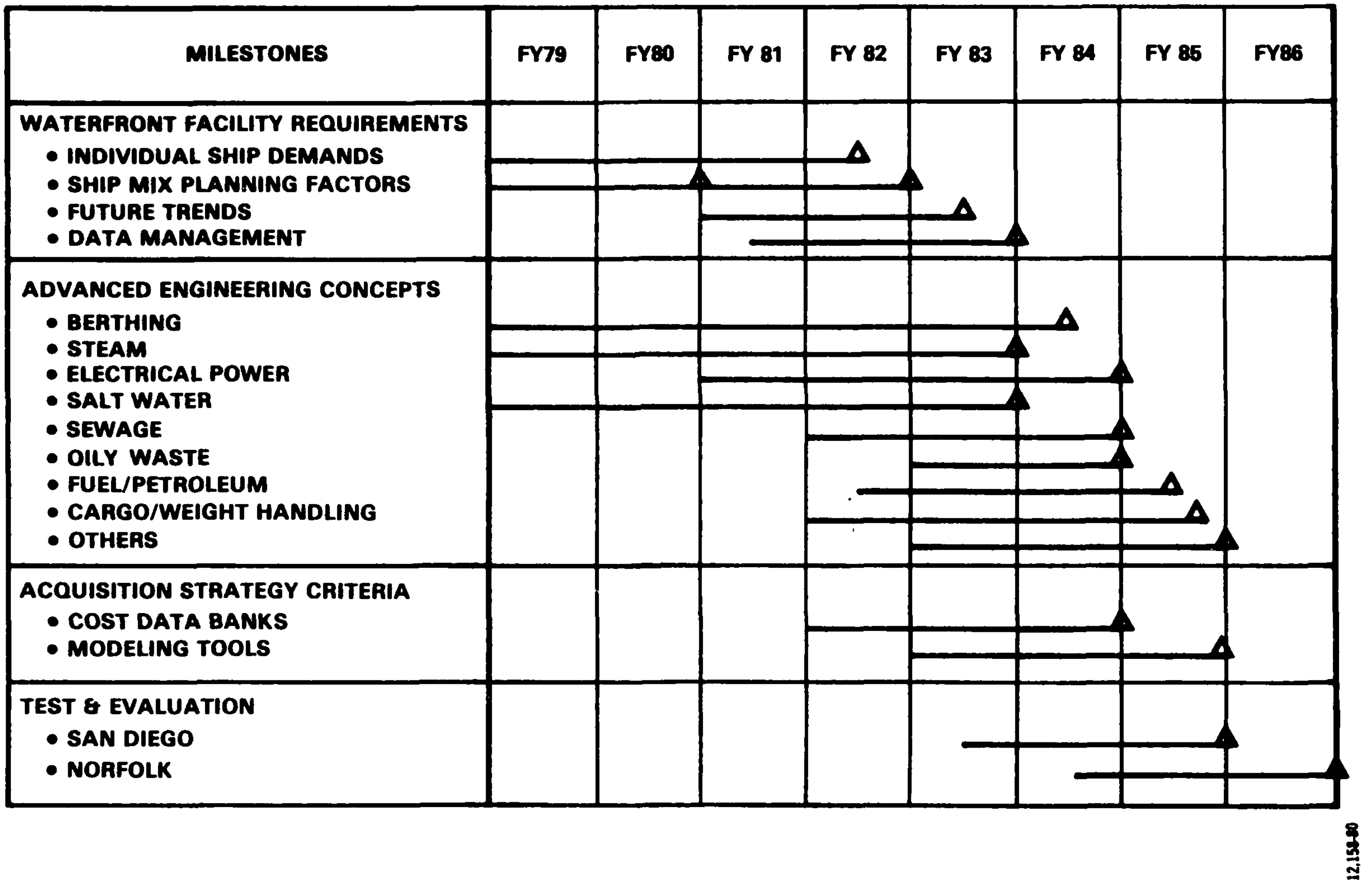

Figure 2-3. Program Development Milestones

Integrated Logistic Support (ILS) will be an early and methodic consideration in the conceptual and development work. Each product will be examined and, where appropriate, an ILS Plan will be prepared.

2.3 FUNDING.

The current FYDP funding for the PSP totals $3.99 M for the period FY79 thru 84. Figure 2-4 depicts the required allocations for the program and the current FYDP funding.

PROGRAM TASK	PROGRAM FUNDING AND PLANNED ALLOCATIONS $ IN THOUSANDS								TASK
	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85	FY 86	TOTALS
WATERFRONT FACILITY REQUIREMENTS									
• INDIVIDUAL SHIP DEMANDS	100	30	300	30					460
• SHIP MIX PLANNING FACTORS	200	60	800	640					1700
• FUTURE TRENDS			30	150	30				210
• DATA MANAGEMENT			50	175	25				250
ADVANCED ENGINEERING CONCEPTS									
• BERTHING	50	40	500	800	250	110			1750
• STEAM	85	30	60	250	120				545
• ELECTRICAL POWER			30	150	250	170			600
• SALT WATER	45	30	130	150	75				430
• SEWAGE				30	40	30			100
• OILY WASTE					50	50			100
• FUEL/PETROLEUM				30	100	50	20		200
• CARGO/WEIGHT HANDLING				30	100	100	20		250
• OTHERS					50	50	50		150
ACQUISITION STRATEGY CRITERIA									
• COST DATA BANKS				50	200	200			450
• MODELING TOOLS					50	150	150		350
TEST & EVALUATION									
• SAN DIEGO					50	100	150		300
• NORFOLK						50	100	150	300
PROGRAM MANAGEMENT	60	20	190	210	140	100	50	30	800
DEVELOPMENT TOTAL	540	210	2090	2695	1530	1160	540	180	8945
CURRENT FYDP	540	200	1100	950	700	500	0	0	3990

12,187-80

Figure 2-4. PSP Program Funding and Planned Allocations

SECTION III
WATERFRONT FACILITY REQUIREMENTS

3.1 INTRODUCTION.

During the past 30 years, there has been a major change in the functions of Navy ports. Not only are todays ports being designed to accommodate larger ships, specialized ships, and ships comprising new technology, but their functions have changed from facilities primarily designed to safely berth and load/unload ships to facilities designed to support a number of diverse activities such as ship repair, crew training, and equipment testing.

In the 1950's, the Navy started providing cold iron services (steam, electricity, water, etc.) to meet the hotel services requirements of ships while berthed at a port. During the last ten years, due to environmental and energy constraints, coupled with the need for dock-side testing and crew morale building, there has been an increased requirement in both quality and quantity of services to be provided at ports. Table 3-1 presents a listing of the types of port services that are required at most Navy ports.

Port facilities built today will be expected to provide service to the fleet during their life span of 30 to 40 years, with minimum life cycle costs. However, port facilities designed and built to meet only today's fleet requirements will soon become obsolete and the Navy will have to resort to expensive retrofit and costly repair and maintenance. These problems must be avoided in the design and operation of future ports.

TABLE 3-1. FLEET DEMANDS FOR PORT SERVICES

BERTHING	– TUGS – PILOTS – ANCHORAGE – PIER SPACES – CAMELS – BROWS AND LADDERS
HOTEL	– ELECTRICAL POWER – STEAM – POTABLE WATER – SEWAGE DISPOSAL – TELEPHONE SERVICE – SALTWATER SERVICE – TRASH REMOVAL – OILY WASTE
MATERIAL HANDLING	– WEIGHT HANDLING EQUIPMENT – TRUCK DELIVERY
INDUSTRIAL SUPPORT	– ELECTRICAL POWER – COMPRESSED AIR – HAZARDOUS MATERIALS
PERSONNEL SUPPORT	– PARKING – MEDICAL – PUBLIC TRANSPORTATION – HOUSING, EXCHANGE COMMISSARY – TRAINING – WELFARE, RECREATION
OTHERS	– FUEL/PETROLEUM

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This section will detail the development approach to develop a dynamic forecasting model to predict what port services demands are needed and how much should be provided as the fleet changes in composition, size, and homeporting plans.

3.2 Identification of Problem.

The basic problem in providing port services to the fleet while ships are in port is determining the performance criteria for the required services at a pier or a port. The problem could be readily solved if all Navy ships required equal amounts of service, if the same ship were always berthed at the same location, and if there were no changes in ship homeport assignments, weapon systems and operations; but these situations do not, in fact, occur.

At present, shore services are based on criteria provided in NAVFAC design manuals. These manuals present utility service demand data for the various ships of the fleet and diversity factors for determining the design loading for a specific utility for a specific berthing plan. This method for determining service requirements does not account for the variances associated with the given service demand and the randomness of the request for this service. The variances in service demand requirements of a ship are caused by its operational mode, complement aboard, and geographic location.

The current methods for determining performance criteria are static and are based mostly on present day needs. Due to the rapid technological development in ship systems and changes in fleet operations, port demands are changing very rapidly and the data provided in the design manuals is out of date by the time the information is printed.

3.3 Development Effort.

To develop a dynamic forecasting model for predicting what port services demands are needed and how much should be provided as the fleet changes in composition, size and homeporting plans, it is necessary to have data on individual ships requirements, together with methods for combining (aggregating) the individual requirements and procedures for keeping the data updated. The approach will be to select the classes of ships that will be around during the 1990-2010 time frame, generate data on their current support demands, future trends in ship designs, operational procedures, and environmental/energy procedures and develop procedures for updating and managing this data.

3.3.1 Data on Ships Demands.

The objective of this effort is to acquire, assess, and record data on support usage by ships while in port. For the indivudal ship demands, usage studies will be conducted to determine the normal and peak requirements for each class of ship while in port. These demands will be broken down by the various platforms of the ships, such as weapon systems, hotel services, engineering systems, and propulsion systems. Variances in these service demand requirements caused by environmental and operational factors will also be documented. Most of this data will be acquired from the Naval Sea Systems Command (NAVSEA).

After the individual ship demands have been identified, planning factors will be developed for combining these demands into realistic port loading requirements. Ship activity has an impact on the type, frequency, and amount of shore services and waterfront facilities required. Data will be developed on port loading factors to determine the maximum and typical busy day ship loading at a port and dispersion factors for service demands to be applied in cases of multiple berthing

or nesting of ships. In-situ measurements will be conducted only as a last resort to acquire this information. Some pertinent measurements and data collection efforts have and are presently being conducted under other dedicated Navy programs. Some Public Works data is available based on readings of meters located in generating plants and distribution systems. There has also been recent studies of shipboard systems that contain relevant data. Data from these various services will be compared to determine the extent of metering required.

3.3.2 Data on Future Trends.

The objective of this effort is to identify, assess and record data on future trends in fleet operations that will impact on port demands. Identification of the composition of new classes and numbers of ships that will be introduced into the fleet from 1990 through 2010 will be accomplished by interviews with OPNAV and NAVSEA personnel. Projections of future weapon systems, hotel services, engineering systems, propulsion systems, fleet operating procedures and their impact on service demands will be made based upon interviews, publication reviews, as well as using appropriate trend projections and statistical methods.

3.3.3 Data Management.

The objective of this effort is to develop the appropriate tables, models, and analytical techniques to predict the probabilistic port service demands as the fleet changes in composition, size, and homeporting plans. Procedures for updating this data will also be developed.

SECTION IV
ADVANCED ENGINEERING CONCEPTS

4.1 INTRODUCTION AND BACKGROUND.

This section details the effort required to develop engineering and cost effectiveness data on alternative facilities, equipment, and operational concepts which will best meet the anticipated port needs of the fleet of the 1990s. Basically, the effort involves the identification of existing and future problems and the conduct of engineering studies and experiments to develop performance, reliability and cost data on various new waterfront facility concepts.

4.2 IDENTIFICATION OF PROBLEMS.

Table 4-1 presents the existing problems that have already been identified.[1] The identification of existing problems with various port services will be a continuing process throughout the PSP. This will be accomplished by discussions and workshops with personnel from the NAVFAC Headquarters, EFDs, base operating personnel, and ships personnel.

Future trends and ship operations will be analyzed to identify potential port services problem areas. Detailed investigations will be conducted into these areas.

4.3 ENGINEERING STUDIES AND EXPERIMENTS.

The background of existing problems, identified in Section 4.2, are summarized, and the approaches for problem solution are discussed in detail in the following sections.

---

[1] CEL TM No. M63-77-4, A Survey of Some Waterfront Facilities at Selected Navy Ports and Bases, June 1977.

TABLE 4-1. EXISTING PORT SERVICES PROBLEMS

SERVICES	PROBLEMS
Berthing	• Congestion on Piers • Fender Maintenance • Dredging • Tug Boats • Ingestion Fouling
Steam	• Availability, Quantity Quality and Pressure • Outlet Spacing • Hose Life and Handling • Condensate Return Valves and Traps • Insulation Breakdown
Electrical Power	• Distribution System on Piers • Cable Handling • Quality of Power
Salt Water	• Inadequate Flow Rate and Pressure for Firefighting
Sewage	• New System Implementation Problems (Hose Cleaning, Discharge Surges, Etc.)
Oily Waste	• Many New System Problems Including Validating Quantities and Qualities of Discharge; System Analyses; Equipment Development; and New Regulations, Criteria, Guidelines and Codes
Solid Waste	• Hand Carried Off Ship • Dumpsters Occupy Pier Space • Industrial Waste Handling
Fuel/Petroleum	• Not Available Pierside
Ammo/Ordnance	• Waivers Phasing out • Increased Restrictions • No Barriers/Designs • Localized Procedures
Cargo/Weight Handling	• Crane Availability • Contractor Provided Equipment • Increasing Weight and Reach Requirements
Personnel	• Brows • Parking • Pier Lighting
Compressed Air	• Quality • Quantity • Availability

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4.3.1 Berthing.

4.3.1.1 Background. The problems in berthing center around the following: (a) congestion on piers, (b) fender maintenance, (c) dredging, and (d) tug boats.

The selection of a berth for an incoming ship depends upon the matching of space, utilities, and support services available at a pier location with the ship's requirements. The present utilities distribution systems on piers requires jury rigging of these systems to provide the ship's demands. Increasing industrial activity on piers places demands on pier deck space. There is a continuous stream of trucks and equipment traffic delivering supplies, performing services and carrying away waste products. The pier deck also serves as a storage area for equipment, repair materials and supplies. All of these factors create a major congestion problem on today's piers.

Camels and fendering systems are a source of problems at Navy ports, particularly at those stations which support a variety of hull shapes or a large number of ships. High costs are involved in replacing damaged fender piles and maintaining camels. For example, at the Naval Base, Pearl Harbor, the estimated yearly maintenance cost for repairing damaged fender piles is 955,000 dollars.[2]

Over the past years, the draft of Navy ships has gradually increased with adoption of larger and heavier onboard ship components such as weapon systems. Maintaining channel and slip depths to accept increasing ship draft is a serious problem at a number of present ports. In addition to becoming increasingly expensive, dredging requirements will impact both the structural integrity of existing piers and the availability of berthing spaces since they are lost during dredging operations.

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[2] PWO Naval Base, Pearl Harbor, ltr of 29 Nov 1977, Subj: Waterfront Maintenance at Pearl Harbor

Because of limited maneuverability of most ships at slow speed, tug boats are usually required for berthing. At present, only minor problems associated with availability and scheduling of these boats have been identified. However, as most of these tugs age, maintenance downtime will increase and availability may decrease.

4.3.1.2 Approach.

The following actions will be undertaken in the berthing area:

Congestion on Piers.

To alleviate the congestion problem and improve the operational effectiveness of piers, alternative pier concepts will be investigated. Types of engineering studies to be conducted in this area include:

a. Comparison of Special Purpose and Multi-purpose Piers.
To accommodate and service all classes of ships at a pier, the trend is to build bigger and structurally stronger berthing piers at Navy ports. Presently, piers 80 feet wide to support 100 ton capacity mobile cranes are being built, and plans are to increase these widths to 100 or 120 feet to further improve pier access and movement in support of the many types of activities currently being required at piers. Studies will be conducted to develop data for comparing the requirements for special versus multi-purpose piers based not only on pier acquisition costs but also costs of ship relocations, enlisted personnel savings, and inconvenience.

b. Double Deck Service Tunnel and Movable Piers.
Increasing industrial activity, utility demands, and environmental concern for waste handling facilities have created an unattractive appearance, safety hazards and difficult working conditions on piers. Piers need to be configured to allow noninterference between required pier operations, such as day to day personnel and cargo movements and fire lanes access, and

pier support services, such as utilities, ship maintenance services and temporary storage. Alternative concepts, such as double deck and service tunnel piers, will be investigated to determine their affordability, performance potential, and maintainability for meeting these requirements in a cost effective manner.

c. Contingency Utilization of Commercial Waterfront. An evaluation of commercial piers/waterfront facilities will be conducted to determine their potential uses for the berthing of Navy ships. This alternative would be considered for use in a contingency situation.

Fender Maintenance.

Data will be obtained to define the problems associated with fenders and camels at various stations. While good designs appear to be available, a lack of coordination between installed designs and operational procedures exists at specific ports. The problem will be assessed under NAVFAC's Exploratory Development Program* in FY79-80. Development items identified from this study will be pursued under the PSP.

Dredging.

A Navy Committee, consisting of a broad spectrum of expertise and responsibility (NAVFAC, NAVSEA, Fleets) on sea suction fouling, has been formed to study the dredging problems at specific sites and plan appropriate action for alleviating these problems. New technology has emerged from 6.2 Research that if fully developed and implemented can result in significant savings of dollars and operational availability. Studies and experiments to develop capital and operating costs, systems effectiveness, maintenance requirements, and environmental impact data for various alternative concepts for reducing the dredging problem will be conducted.

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* PE 62760N Logistic Technology

Tug Boats.

Alternate facility, shipboard, and operating concepts for docking ships will be identified and investigated. Their desirability in terms of performance, effectiveness, and feasibility in terms of implementation likelihood will be assessed. Cost effectiveness data and utilization plans will be developed for the following: (a) mooring winches on ships and on piers, (b) commercial versus Navy tugs, (c) underwater tracks, and (d) bow thrusters. This effort is also intended to point to the best mix of concepts to serve Navy needs cost effectively.

4.3.2 Steam.

4.3.2.1 Background.

Shore steam is provided as a cold iron utility service to ships at most homeports. For the most part, this steam has been used to provide hotel services (heat, galley, laundry, etc) to ships while berthed at port. Due to the enforcement of port side environmental protection regulations, coupled with the need for increased energy conservation and sailors morale, it is now becoming both operationally desirable and more economical for today's fleet to use shore steam to blanket their boilers while berthed at port. In addition, ships would like to make feedwater onboard using shoreside steam. In San Diego, a savings of approximately $50,000 per month is possible by eliminating commercial procurement of feedwater.[3]

There have been numerous complaints about the quantity, quality, and pressure of shore steam. One of the major difficulties is supplying steam to ships while nested. When nesting, the second and third ship outboard usually gets "nothing but hot water." Because of long steam lines between

[3] WESTNAVFACENGCOM San Bruno, CA Msg 161656Z Dec 78

pier and steam plant, defective steam traps and poor insulation of the steam lines, unacceptably high levels of moisture are reported in shore steam. Additionally, ships do not return condensate to shore, thus in areas where steam is generated mostly for waterfront applications, there is 100 percent makeup water requirement at the shore steam plant. The steam hoses used to supply shore steam to ships deteriorate and release particles to the steam flowing through the hose. Strainers are used between the hoses and the ship's hose connection, but they are not a satisfactory solution in that they eventually become clogged.

4.3.2.2 Approach.

The steam development effort includes engineering studies and experiments in two areas, steam quantity and quality and rigid hose systems.

Steam Quantity and Quality.

Cost effective methods for providing the peak flow rates to individual ships will be determined, analyzed and tested. These peak flow rates will be identified under Section III, Port Demand Data. Some options that have been identified are:

a. Steam Separators Pierside. Separators are used in industrial process systems to separate moisture and solids from gas. Moisture carries with it much of the undesirable mineral content presently in steam, and if the moisture can be separated from the gas, dry steam meeting NAVSEA specifications for shipboard use may be provided. Engineering experiments will be conducted to determine the effectiveness of steam separators for producing clean, dry steam, and to develop new ones, if needed.
b. Closed-loop Steam System on Piers. In most locations, condensate return lines are not provided on piers. For instance, at San Diego, of the steam produced, 80 to 95 percent supplies ship's services steam needs and is discharged overboard because no condensate return lines are installed at the piers. Recent studies indicate

that the provision of condensate return lines on these piers may accomplish the goal of providing steam good enough for blanketing ship's boilers and for supplying steam condensate for use as feedwater. However, it is not known if ships can currently return condensate to the pier deck. Engineering studies and investigations will be conducted to determine whether: 1) installing condensate return lines and the necessary booster pumps on piers; and 2) ship alterations to return condensate to shore is cost effective.

Rigid Hose System.

Rigid conduit systems, with multiple swing joints, installed in commercial ports for bulk loading/unloading will be evaluated for use for shore-to-ship steam transfer. Engineering data and design recommendations will be developed. Pilot installations will be evaluated and personnel criteria/standards developed. Reduction of flexible hose material will reduce proportionally the loose particles as hoses become brittle.

4.3.3 Electrical Power.

4.3.3.1 Background.

The basic problems associated with electrical power at Navy piers can be grouped into the following areas: (a) availability of reliable shore power and (b) difficulties of handling heavy electrical cables.

In many cases, ships frequently have to use shipboard power while berthed because the shore power is inadequate to meet the demands of the ships. This problem is created because of the increased demands of the newer ships of the fleet and the inflexibility of the power distribution systems on existing piers. Berthing plan changes at Naval Stations can result in adequate power not being available on the pier or power not being available at the required location on the pier.

Shore-to-ship power cables cost \$12 to \$15 per foot, plus \$600 for each end connector. They are extremely heavy (6 lb/ft). A variety of

methods and equipment have been developed by and are now being used at different Naval Stations for storing and handling these cables. None of these methods present a neat appearance at the pier. Generally, the excess cable is bunched together and piled like spaghetti on the pier. Cable life average is only four years, which is less than half of the ten-year design life. In addition, splices in the cable, located every 125 feet in the standard available cable, contributes to an unsafe and still heavier distribution cable. When running to the outboard ship in a nest, these hazardous conditions become even greater.

4.3.3.2 Approach.

Electrical power demands for ships will be identified and analyzed as described in Section III, Waterfront Facility Requirements. Engineering and cost effectiveness investigations will be conducted on alternative electrical power distribution systems for piers. This will include the development of outlet spacing guidelines and concepts for providing increased flexibility during periods of high demands and changes in berthing plans.

An experimental power cable handling unit* will be tested and evaluated. This unit consists of: (1) a power assisted reel unit which may be transported by and operated from a conventional forklift, and (2) a power assisted retractable telescopic elevation unit to lift cables on board ships. These tests will develop the operational and economic benefits of the handling system and the results will be used to design and test another concept or to prepare procurement specifications.

4.3.4 Salt Water.

4.3.4.1 Background.

A salt water supply system is required for two basic purposes, fire protection for piers and ships and shipboard flushing and cooling.

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* Developed under the Exploratory Development Program

Interpretation of NAVFAC Design Manual (DM-25) criteria has resulted in a proliferation of salt water pumping stations designed to meet fire flow requirements. As a result, the supply conditions vary considerably.

PWC San Diego[4] has conducted a preliminary investigation of the salt water service conditions prevailing in San Diego. The conslusion was that the shore and pier salt water system has not been and would likely never be used by the Station Fire Department. Utilization of salt water for fire fighting has many drawbacks from a personnel as well as equipment damage standpoint. For the majority of shipboard fires, adequate fresh water supply is generally available. In the event of a major fire, pumpers can readily draft from the bay for any salt water fire fighting requirements.

In general, most ships indicate a preference for using pier supplied salt water instead of their own fire pumps if the proper pressure and flow can be maintained. This will allow a reduction in pumps operation wear and permit periodic repair and overhaul as necessary. Therefore, a critical evaluation of the cost effectiveness of installing and maintaining a marginal salt water fire fighting system needs to be made.

4.3.4.2 Approach.

Precise information will be developed on the ship's flushing, cooling and fire fighting flow requirements. This data will be identified under Section III, Waterfront Facility Requirements.

Engineering studies will be made to compare the cost of operating shipboard pumps versus shoreside pumps. Concepts will be developed for providing salt water to meet the ship's requirements.

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4 PWC San Diego, ltr 600: REM:brc, 11330 ser 01088, dtd 17 Jun 77, Subj: Ship-to-shore Saltwater Systems

4.3.5 Sewage, Oily Waste and Solid Waste.

4.3.5.1 Background. Due to increasing environmental concern, ports have to operate under increasingly strict requirements for handling sewage, oily waste and solid waste. At present, most ports have sewage lines installed on the piers, and collection, holding and transfer (CHT) systems are currently being installed and certified on ships in order to handle ship-to-shore sewage transfer problems. Existing laws dictate that all ships must stop discharging sewage waste water into U.S. harbors by April 1, 1981.

Oily wastes are generated throughout Navy ships. Since the discharge of a visible sheen of oil is prohibited within 50 miles of the U.S. coastline, oily water on board ships must be minimized and treated, and waste oils held for discharge to shoreside receiving facilities. Currently, prototype oily waste collection lines have been installed at three locations and assorted containers (SWOBs, YONs, DONUTs) are being used at other locations for the collection, transportation and disposal of oily waste.

All ships and ports generate significant amounts of solid waste. The problem in handling solid waste results from the requirement to locate large dumpsters on the piers, adding to pier congestion. Solid waste from ships is usually offloaded by ship's personnel into pierside dumpsters which are hauled away by either Public Works personnel or a contractor. Several types of industrial compounds used aboard ships and handled through ports require special consideration because they are hazardous.

4.3.5.2 Approach.

The Navy Environmental Protection Program (NEPP) and Pollution Abatement Program are addressing many of the problems associated with sewage, oily waste and solid waste at Navy ports. The on-going work in these programs will be monitored to determine the impact of the various

alternative solutions developed in each of these areas on the overall waterfront concept to assure integration with this program and to avoid imcompatible design concepts. The requirements to accommodate and service the required sewage and oily water lines will have an impact on the pier concepts of the future and in upgrading existing piers.

4.3.6 Fuel/Petroleum.

4.3.6.1 Background.

Fuel supply and transfer practices vary from port to port. Many ports do not have fuel available pierside. At different ports, some types of fuel are brought to the pier by barges, some types of fuel are available through pipelines, and some types of fuel are brought pierside by trucks. Systematic advance planning of fuel transfer facilities and methods for future ports could significantly reduce logistics, costs, personnel and equipment required for fuel transfer, and the incidence of harbor oil spills.

4.3.6.2 Approach.

Alternative methods of providing fuel to ships berthed at various types of piers will be investigated. This effort will include a cost effectiveness study of fuel available at berthing piers versus dedicated fuel piers. The solution for providing fuel at ports will be identified.

4.3.7 Ammo/Ordnance.

4.3.7.1 Background.

With increased safety regulations, ammunition handling operations have become more complicated. Special waivers are often required for ammunition handling. Because distance is the principal safeguard against accidental explosion, only remote piers or portions of piers may be used for ammunition handling. This results in problems of scheduling ships

to receive/offload ammunition, increased tug operations, and increased interface with other activities. These special waivers will only be permitted until safe ammunition handling facilities can be developed or located elsewhere.

4.3.7.2 Approach.

The efforts of the Explosives Safety Program will be monitored to determine their impact on the waterfront facility concepts to support the fleet of the 1990s. This data will be used to develop criteria for new facility designs, which may include design of retrofit barriers.

4.3.8 Cargo/Weight Handling.

4.3.8.1 Background.

Increasing industrial activities on piers are creating a demand for larger and more weight handling equipment. To handle these requirements, there is a large number and a wide variety of cranes and conveyor systems in service at many ports. Some of the problems in this area are: a) the equipment available is of the wrong type or size because of changing requirements, b) the equipment is not available when needed, and c) the equipment creates congestion problems on piers. PWC San Diego[5] recently completed a study to determine the crane service requirements at the Naval Station. This study found that the portal cranes, which were a sizeable investment, at San Diego are rarely used with about 85 percent of the crane work now accomplished by floating cranes and truck cranes.

4.3.8.2 Approach.

The cargo/weight handling demands at various ports will be identified under Section III, Waterfront Facility Requirements. These demand data will be analyzed and cost effectiveness studies conducted to determine the

[5] PWC San Diego ltr Report, Truck Crane Service, Naval Station Pier, San Diego, Calif, 20 June 1977

optimum mix of cargo/weight handling equipment and the impact on facilities design.

4.3.9 Personnel.

4.3.9.1 Background.

Problems have been encountered in the areas of brows, parking, and pier lighting. Problems in the area of brows are due to the changing heights of the ship decks and varying tide conditions. A shortage of parking spaces appears to be a very common complaint. A general safety hazard exists with pier lighting that is inadequate and, in many cases, does not define the edge of the pier.

4.3.9.2 Approach.

Engineering studies will be conducted to determine the people flow requirements, estimate near and long term future transportation expectations of Naval personnel, and devise appropriate transport concepts for ship's personnel into the Naval Station. Special design lifts for personnel movements for selected pier/ship combinations will be evaluated. Alternative means of transportation to and from the base should be factored into port systems design to alleviate the parking problem. The problems associated with pier lighting will be assessed and appropriate solutions will be provided.

SECTION V
ACQUISITION STRATEGY CRITERIA

5.1 INTRODUCTION.

Presently, most Navy ports are planned and designed based on an official homeporting plan for that activity or station. This published homeporting plan is used to generate resource requirements to support specific numbers and types of ships to be homeported at that station. Due to strategic, tactical, and operational decisions, these homeport assignments change and become obsolete. Thus, the facilities designed to a fixed berthing plan are likely to become dated and inadequate to meet the present requirements.

As the functions of ports change, decisions on design, expansion, operations, investment, and other matters require a more detailed study. Traditionally, ports have been developed based on near term projections of demands for port services which are then used to provide inputs for design, engineering, and development of operational policy.

A port system is defined in terms of the services provided. These services can be defined logistically in terms of the resources available and the operational rules governing their assignments. The resources available include facilities (piers, wharves, etc), equipment (tugs, cranes, and barges), and operational personnel. The operational rules include those governing the assignment of resources in space and time, the priority of services and the maintenance of service queues.

Over the past decade, a number of modeling theories have been developed that can be used to translate changes in service demands into probabilistic distribution functions for service time. These models and analytical techniques can be used to define the relationship between the commitment of resources to the activity and the resulting impact to the fleet in terms of readiness, availability, and operational considerations. Models and analytical techniques are needed that can be used to generate design criteria and alternative investment schemes for port development of the future and the probabilistic benefits associated with the various criteria and level of investment.

5.2 Identification of Problems.

An analysis of the capabilities of the Navy's major homeports to berth the ships contemplated in the planned ship building program has identified a major deficiency in their capability to serve the fleet in the 1990s. The question then arises as to what is the most efficient investment in port facilities, or how should a port invest the capital required to best increase the port capacity? Decisions such as should we repair, replace, expand or modify the existing facilities; should we design for today's requirements or to 5, 10, 20 years in the future; should we change operational procedures, etc., must be considered. Models or techniques must be developed to identify the tradeoff positions and alternatives while ensuring the needs of the operating forces are being met.

5.3 Development Effort.

Cost models and estimating algorithms will be developed for various facilities and Fleet options for increasing the capacity of Navy ports. Methods and techniques will be developed to evaluate the various options

from an operational, availability, and Fleet readiness standpoint. These models, techniques and methods will facilitate decisions in facilities investments, waterfront operating procedures, and changes in ships designs.

5.3.1 Cost Data Banks.

Cost models and estimating algorithms will be developed for three basic cost elements. First, the fixed cost of the capital investment in port facilities plus the fixed cost associated with maintenance and operations of these facilities for the various facilities options will be developed. The second cost element will be for the day to day operations in a port for providing services. This cost represents primarily the labor and operating cost associated with connecting and disconnecting service lines, handling cargo/materials, and movement of ships. The third cost element is the cost to the ship while in port. This cost represents ship readiness downtime, shipboard wear/tear, ship operational availability and sailors time.

5.3.2 Readiness Measures.

Methods to enhance the maintenance readiness of the ships berthed in a port will be developed. This will include considerations of providing appropriate and sufficient services to decrease ship readiness downtime, reduce shipboard equipment wear, and conserve the time of ship personnel. Also, planning for alternate berthing of ship in emergency situations will be conducted.

5.3.3 Decision Tools.

Tools will be developed to translate the service demand data and the cost data into facility requirements. These tools will enable the evaluation of options and will facilitate decisions between solutions that require resource investments or changes in fleet operations and homeporting policies. Some of the facilities requirement tools, that will be developed, will provide designers with the following:

a. Models to assess changes in operational rules including service sequencing, scheduling, and priorities on productivity at a port.
b. Models to assess alternative schemes between facility investment versus operational procedures.
c. Models to predict the results of various options and provide a range of solutions from the optimum to least desired.
d. A compilation of unit cost data for the various elements. This would include cost on facilities, ships, and operational procedures.

SECTION VI

TEST AND EVALUATION

6.1 INTRODUCTION.

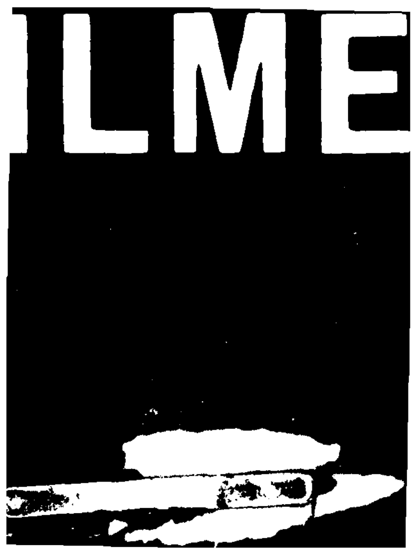
The results of the developments in this project will be demonstrated in the development of notional ports located in San Diego, California, and Norfolk, Virginia. This will provide a validation of the models.

6.2 Notional Ports.

The Navy ports at San Diego, California, and Norfolk, Virginia, will be analyzed and the tools developed in the service demand and facilities requirement efforts will be applied. This will result in an optimal notional port recommendations for both San Diego and Norfolk.

The service requirements for each port over a period of time will be determined. Using the service demand tools, the expected usage rates and frequency of peak usage rates for each service for a specific location on a pier, a specific pier, and a berthing plan will be developed.

Using the service demand data and the engineering and operational data, models will be used to translate this into facility requirements. The models will be used to assess changes in operational rules including service sequencing, scheduling, and priorities on productivity at each of the ports. Alternative schemes between facility investment and operational procedures will be assessed. A range of solutions from the optimum to least desired will be provided.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